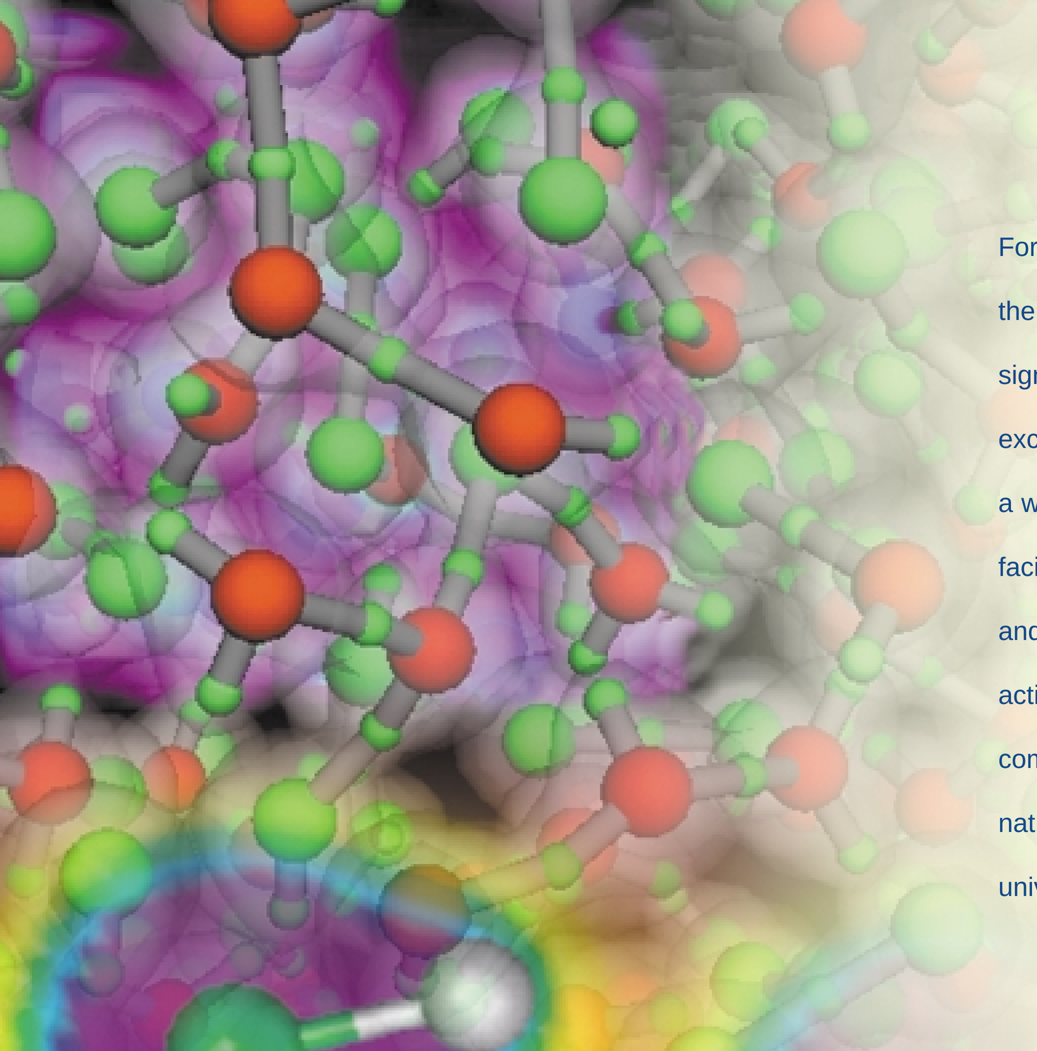


Pursuing Breakthroughs in Science

For 50 years, innovative scientific research at the Laboratory has helped the nation deal with significant threats to security. Livermore's exceptional workforce meets the challenge using a wide range of special capabilities and unique facilities. Pursuing demanding problems in basic and applied science, Livermore researchers actively participate in the international scientific community, collaborating with colleagues at other national laboratories, research centers, and universities.

On the Cutting Edge of Scientific Computing

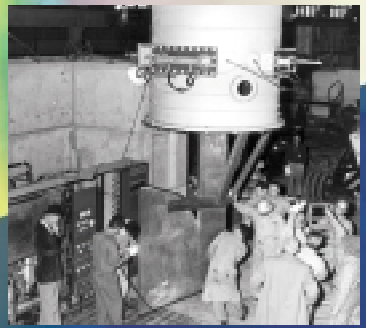
Research projects on the frontiers of scientific supercomputing were featured when Livermore celebrated Science Day on March 21, 2001. Dignitaries, Laboratory employees, invited guests from the local community, and the media gathered to hear presentations, tour facilities, and view poster presentations in the day-long event. Science Day was held to mark the Laboratory's many scientific accomplishments. In attendance were NNSA Administrator General John Gordon, acting DOE Office of Science Director James Decker, and University of California Provost and Senior Vice President C. Judson King.

Science Day presentations demonstrated that high-resolution, three-dimensional (3D) scientific simulations are an essential part of virtually every major program at Livermore. Laboratory researchers summarized work on 8-billion-zone simulations of turbulent mixing, calculations to predict the 3D shape of proteins, multiscale modeling of material properties, and quantum molecular dynamics calculations to determine the properties of matter at high pressure. Simulations are moving from a supportive role for theory and experiments to a starring role—they are becoming a principal tool for scientific discovery and analysis.

Weapon scientists at the Laboratory are moving closer to the goal of full-scale simulations of weapons performance based on first-principles physics models with the advanced computing capabilities made possible by NNSA's Advanced Simulation and Computing (ASCI) program. Other Livermore programs have access to terascale computing through the Laboratory's Multiprogrammatic and Institutional Computing Initiative. Scientific supercomputing is leading to unprecedented levels of understanding in biology, climate and weather modeling, environmental studies, the design of new materials, and many areas of physics.

Some of the cutting-edge scientific research conducted on supercomputers at the Laboratory is supported by DOE's new Scientific Discovery through Advanced Computing (SciDAC) program. In 2001, Livermore and collaborators received more than $23 million from SciDAC to study subjects including supernovae, climate modeling, plasma microturbulence, and development of supercomputer simulation tools. The Laboratory is participating in 10 SciDAC projects and leading 2 of them.

1950s



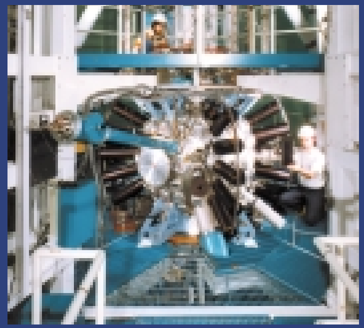
The physics governing nuclear weapons performance was the first focus and remains a continuing one for Laboratory researchers. Throughout its history, Livermore has been at the forefront of studying the properties of matter at extreme conditions (up to stellar temperatures and pressures) and studying the interaction of matter with intense radiation.

1960s

Photo: Adam Block/NOAO/AURA/NSF

Astrophysics and nuclear weapons physics have many similarities, and in the 1960s, Laboratory researchers authored key papers on gravitational collapse and supernova explosions. The discovery of dark matter in the form of massive compact halo objects (MACHOs) is just one recent example of Livermore's continuing contributions to astrophysical research.

1970s



The Laboratory launched its Laser Program in 1972 and, with its 20-beam Shiva laser in 1977, became preeminent in laser science and technology. Break-through advances in lasers and electrooptics include the world's most powerful laser (the Petawatt in 1996), the brightest (JanUSP in 1999), and the largest (the National Ignition Facility under construction).

1980s

Photo: AP/Jonas Ekstromer

Important breakthroughs in the 1980s included work by Robert Laughlin (above, left) on the fractional quantum Hall effect, for which he was awarded a Nobel Prize in 1998, and the development of x-ray lasers. Livermore's Novette laser was used to produce the plasma conditions necessary for lasing to occur at soft x-ray frequencies.

1990s

The cessation of nuclear testing dramatically increased the importance of developing a more thorough understanding of the fundamental physics of nuclear weapons. Begun in 1995, the Stockpile Stewardship Program includes a series of campaigns to make necessaryscientific advances to support assessments of weapon performance.